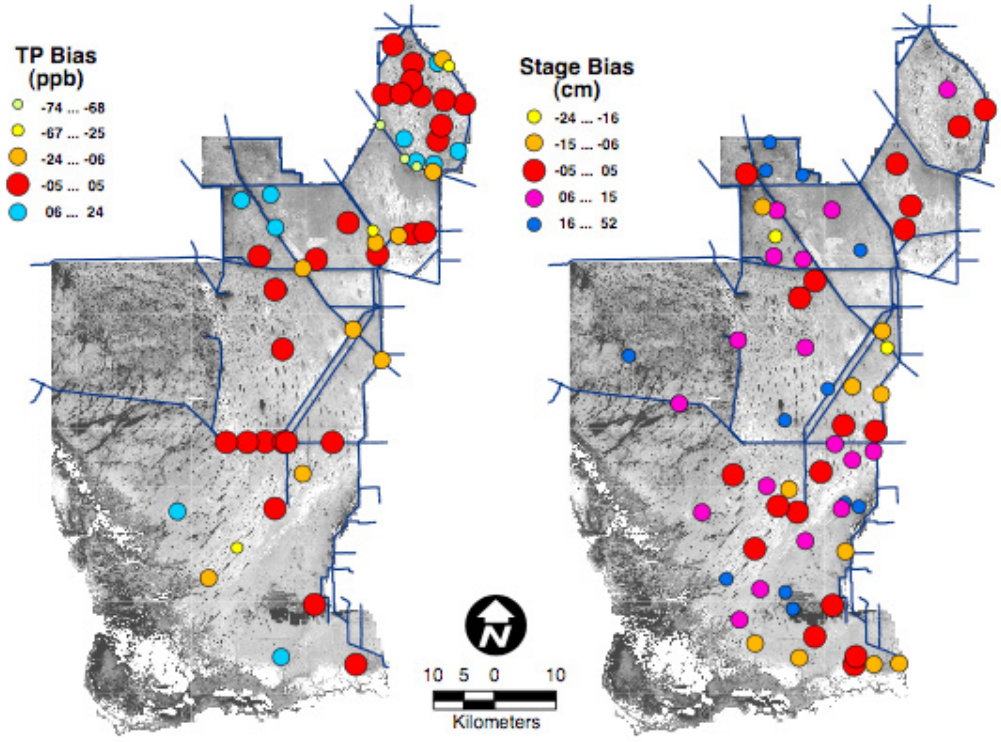
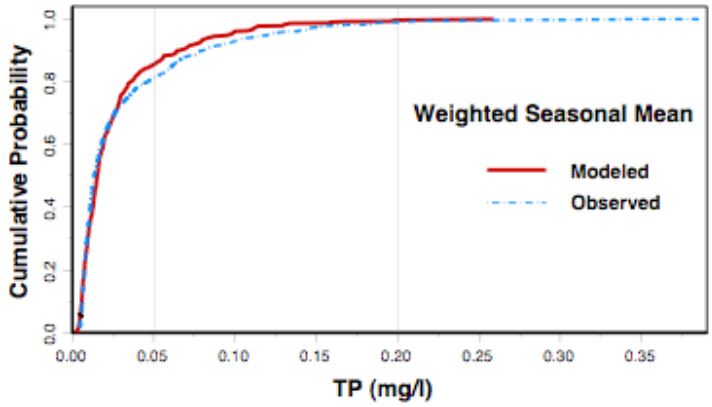
Calibration Performance of ELM v2.1a: 1979-1995 Water Quality and Hydrology



All stations



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http://www.sfwmd.gov/org/wrp/elm/

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Executive summary

ELM objectives

One immediate objective, directly related to this report, is to apply the ELM in evaluations of hydrology and phosphorus water quality at regional and subregional scales for CERP[1] Projects, CERP RECOVER[2], and other Everglades Projects such as CSOP[3]. An updated version of ELM will soon provide other ecological performance measures across the regional model domain.

Document purpose

Following the initial two-month comment & response phase of the RECOVER Model Refinement Team (MRT) review of ELM, the request was made at the November 13 MRT meeting to provide additional numerical analyses of the performance of ELM in its calibration mode. In response, we expanded the statistical analyses of the comparisons between ELM and observed data (i.e., calibration performance measures for model "skill" assessment) for stage height and for Total Phosphorus (TP) concentration throughout the ELM domain. The information herein supplements the Oct 16, 2002 report[4] "Agency/public review of ELM v. 2.1a: ELM developers' response to reviews".

Calibration performance

For general performance assessments, summary statistics including Bias and RMSE were used to assess the model calibration for predictive bias and accuracy. For the stage heights, the overall mean bias and RMSE for all monitoring stations were 6 cm and 23 cm, respectively, for predictions relative to observations. The overall mean bias and RMSE for surface water phosphorus concentration were -0.002 mg/l and 0.026 mg/l. When comparing seasonal means, these bias was 0.001 mg/l and the RMSE decreased to 0.013 mg/l.

Simulated stage heights explained 68% of variability in observed stage heights. Compared to stage heights, the goodness of fit statistics for surface phosphorus concentration were lower, with an overall mean R^2 of 0.10 for the individual simulated & observed pairs. However, when weighted seasonal means were used, the average R^2 improved to 0.20.

Such goodness of fit tests provide insight into the model capabilities, but measures of the magnitude of the model-observed deviations are critical to an evaluation of the efficacy, or "skill" of the model in predictive mode. Overall differences between the model and observed data appear to be within acceptable bounds for making water quality assessments on a regional basis. The spatial north-south trends in water quality, the monthly-seasonal dynamics, and many of the short-term nutrient pulses, are largely captured by the ELM simulation.

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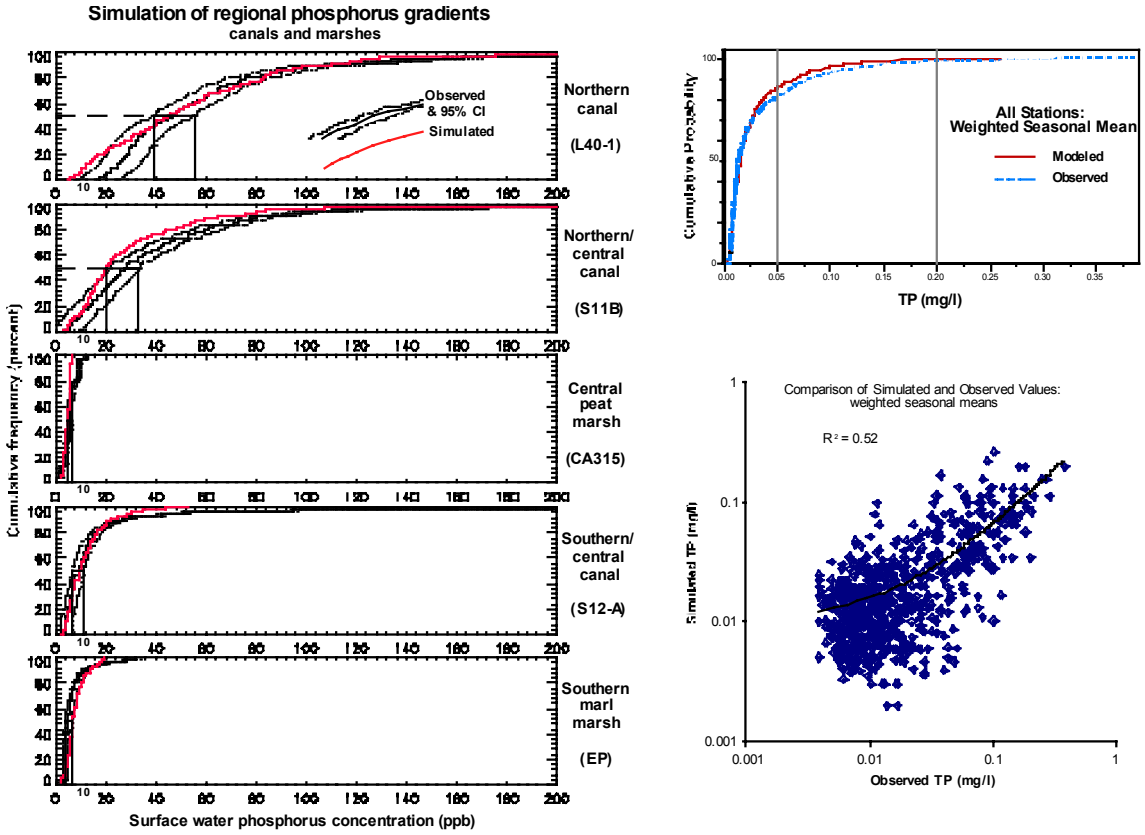
[1] Comprehensive Everglades Restoration Plan
[2] REstoration COordination and VERification
[3] Combined Structural and Operational Plan
[4] Available in the "News" section of the ELM web site http://www.sfwmd.gov/org/wrp/elm/



Summary figures: TP predictions: cumulative frequencies and correlations.

We used temporal aggregation to reduces the effects of random errors in observed data. Phosphorus concentration weighted by flow (water control structure stations) or by ponded water depth (marsh stations) is reflective of the relative importance of the total mass/volumes in the system, and can also reduce the influence of extreme values in some situations. When each simulated and observed seasonal mean surface water TP concentration at all monitoring stations were compared, simulated values explained more than 50% of variability in observed values. With further aggregation of seasonal means by each monitoring site, the R^2 increases to more than 0.60; i.e., 60% of the variance in observed values was explained by the simulation results. The cumulative frequency plot for weighted seasonal means for all sites also confirmed a good match of the simulated and observed data. The dry and wet seasonal means appeared to be a useful level of aggregation that was sufficient to minimize the influence of random error, while maintaining an appropriate temporal scale to account for wet/dry seasonal changes in surface water TP concentrations. Furthermore, at this level of aggregation, ELM clearly demonstrates the ability to predict overall seasonal mean phosphorus concentration changes with very good accuracy throughout the greater Everglades.

The various numerical analyses and visualizations in this document should demonstrate that the ELM is a useful predictive tool for hydrologic and water quality analyses in the Everglades. However, the strength of the ELM goes beyond merely predicting these "landscape drivers". While we do not currently present Regional Performance Measures for the other ecosystem variables, these other ecological dynamics are key to understanding and evaluating management alternatives. The rates of growth and mortality of periphyton and macrophytes, the rates of peat accretion and oxidation, along with a number of other ecosystem processes, dynamically interact within the hydrologic

and biogeochemical cycles of the simulated ecosystems. We monitor these variables during the calibration process, ensuring that they remain within reasonable values. Importantly, these variable dynamics form the basis of changes to habitats that are defined by vegetation/periphyton community types and by soils. These changes to landscape attributes are the principal objectives of ELM simulations, and will form the primary basis for ELM ecological evaluations, as has been demonstrated for subregional scales in other publications[5].

[5] Available on web site at http://www.sfwmd.gov/org/wrp/elm